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(54) AN IMPROVEMENT IN OR RELATING TO TWIST DRILL

(71) We, OSBORN-MUSHET TOOLS LIMITED, a British Company of Clyde Steel Works, Sheffield, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

The invention relates to twist drills and has for its object to provide an improvement therein. In particular it is the object of the invention to provide a twist drill which will have an extended life between re-grinds.

According to one aspect of the invention, there is provided a twist drill having primary lands and at least one secondary land associated with each primary land, the secondary lands extending along the body clearance diameter of the drill in circumferentially spaced relation to the associated primary lands, the primary lands being relieved by being chamfered off at an angle adjacent the drill point so that the drill point extends along the edge of a major flank and along the edge of a minor flank produced by the chamfer, the chamfer being such that it runs out into the periphery of the primary land at a greater distance from the chisel edge at the tip of the drill than the major flank runs out at the periphery of the or each associated secondary land whereby each secondary land is caused to stand axially "proud" of its associated primary land and forms a sizing flank for taking a "skimming" cut following the cut taken by said primary land, or alternatively, the primary lands being relieved by the diameter across said primary lands being less than the diameter across the secondary lands for a limited distance from the drill point so that each secondary land is caused to stand radially "proud" of its associated primary land and forms a sizing flank for taking a "skimming" cut following the cut taken by said primary land. The distance over which the primary lands are relieved by being chamfered off at an angle adjacent the drill point or by the diameter across the primary lands being less than the diameter across the secondary lands, as the case may be, will preferably extend less than a distance of twice drill diameter from the drill point. The roots of the drill flutes may be formed in such a way that the "chips" produced when the drill is in work are turned through an angle such that they fracture. In addition, a "chip" space clearance flute may be provided in front of each secondary land.

According to another aspect of the invention, there is provided a method of making a twist drill, the method including the steps of forming a fluted body with primary lands and with at least one secondary land associated with each primary land, and of relieving the primary lands for a limited distance from the drill point in such a way that the drill point runs out into the periphery of each primary land at a smaller diameter than said point runs out into the periphery of each secondary land. Preferably, the step of relieving the primary lands will be effected by chamfering, by grinding, adjacent the drill point so that said drill point extends along the edge of a major flank and along the edge of a minor flank produced by the chamfering operation, the extent of the chamfer being such that a sizing flank of the or each secondary land is caused to stand axially "proud" of its associated primary land. Alternatively, the step of relieving the primary lands may be effected by reducing, by grinding, the diameter of the drill across said primary lands for a limited distance from the drill point so that at the drill tip the sizing flanks of the secondary lands are caused to stand radially "proud" of their associated primary lands.

In order that the invention may be fully understood and readily carried into effect, the same wil now be described, by way of example only, with reference to the accompanying drawings, of which:—

Fig. 1 is a perspective view of a twist drill embodying the invention,

Fig. 2 is an enlarged view of the point end of the drill,

Fig. 3 is a transverse section through the drill on the line 3-3 in Fig. 1,

Fig. 4 is a diagrammatic view which will be referred to presently,

Fig. 5 is a view similar to Fig. 1 of a further form of twist drill embodying the invention, and

Fig. 6 is a transverse section thereof on the line 6-6 in Fig. 5,

Fig. 7 is a perspective view of an end section of a twist drill illustrating a further form of drill embodying the invention,

Fig. 8 is a further diagrammatic view which will be referred to, and

Fig. 9 is a further transverse section which will presently be referred to.

Refering now to Figs. 1 to 4 of the drawings, the twist drill there illustrated is provided with flutes 10 and with primary lands 12 and secondary lands 14 associated with said primary lands. The secondary lands extend along the body clearance diameter of the drill in circumferentially spaced relation to the associated primary lands as shown.

The primary lands are relieved by being chamfered off at an angle adjacent the drill point as best seen in Fig. 2. Consequently, the drill point extends along the edge of a major flank 16 and along the edge of a minor flank 18 produced by the chamfer. The chamfer is such that it runs out, at 20, into the periphery of the primary land at a greater distance from the chisel edge 22 at the tip of the drill than that of the major flank which runs out, at 24, into the periphery of the associated secondary land. Thus, so-called sizing flanks 26 of the secondary lands are caused to stand axially "proud" of the full diameter points 20 of their associated primary lands. In effect, the primary lands are relieved in such a way that the drill point runs out into the periphery of each primary land at a smaller diameter than said point runs out into the periphery of each secondary land. The arrangement is such that each secondary land forms a sizing flank for taking a "skimming" cut (of perhaps only a few thousandths of an inch) following the cut taken by the flank of the associated primary land.

It has been found that since the drill is formed with so-called double margins (that is to say primary and secondary lands) it has extra radial guidance and support. Consequently, rounder holes have been produced than with conventional twist drills. It has also been found that since the final hole sizing is effected by the sizing flanks of the secondary lands and away from the major heat generating zone at the flanks of the primary lands, the hole size accuracy has been increased and the life of the drill between re-grinds has been found to be much greater than that of comparable drills of conventional form. It will also be understood that the space between each primary land and its associated secondary land constitutes a coolant channel which assists in still further extending the life of the drill when a coolant is used.

The angle at which it is required to chamfer the primary lands and the extent of chamfering required can of course be determined by trial and experiment although of course there is a minimum distance which the chamfering must extend axially of the drill so that the sizing flanks stand axially "proud" of their associated primary lands. (This is best seen in Fig. 2 where the sizing flank 26 is shown to be located in advance of an imaginary circumferential line encircling the drill and coinciding with the point 20. The result is also illustrated diagrammatically in Fig. 4 where a sizing flank 26 is shown to stand axially "proud" of an associated primary land or that portion of the primary land which is of the same diameter. The sizing flank stands radially "proud" of the portion of the primary land located axially in advance of it). Generally, however, it can be said that the axial distance d over which the chamfer of each primary land extends should be a minimum of 1/4 of the drill diameter. Similarly, although there is no actual limit on the maximum distance d, it can be said that if the extra radial guidance and support provided by the double margins is to be maintained the distance d should preferably not exceed roughly twice the drill diameter, and of course such extra radial guidance and support is only obtained when drilling to a depth greater than the distance d.

Various modifications may be made without departing from the scope of the invention. For example, in Figs. 5 and 6 there is illustrated a twist drill which is identical to that described above except that the roots of the drill flutes 10 have been formed in such a way that the "chips" produced when the drill is operating are turned through an angle such that they fracture.

In a further modification as shown in Figs. 7 and 8, a twist drill which has a pair of primary lands and a pair of associated secondary lands has had its primary lands relieved by having the diameter across said primary lands reduced by grinding for

a limited distance *d* from the drill point (by perhaps only a few thousandths of an inch, and the amount *t* shown removed in the drawing has been exaggerated for the sake of clarity) so as to be less than the diameter across the secondary lands. Thus it will be seen that the sizing flanks of the secondary lands stand radially "proud" of their associated primary lands. This is shown diagrammatically in Fig. 8. The result is thus the same as that described with reference to Figs. 1 and 2; the primary lands remove the greater amount of metal during a drilling operation but the secondary lands control the final hole size. Intense heat is generated in the region of the primary lands but the sizing flanks operate at a comparatively cool temperature. It will of course be understood that this modified form of drill operates in a way substantially the same as that illustrated in Figs. 1 to 4. The reduction of diameter across the primary lands extends for a distance such that the sizing flanks stand axially "proud" of their associated primary lands and preferably somewhat more than that to allow a generous margin for re-sharpening of the drill by grinding of its major flanks alone. However, as in the case of the drill illustrated in Figs. 1 to 3, this distance should preferably not exceed roughly twice the drill diameter so as to maintain the extra radial guidance and support, and of course such extra radial guidance and support is only obtained when drilling to a depth greater than the distance *d*. The dimension *t* by which the primary lands have been relieved may be determined for best results by trial and experiment. However, it can be said that depending on the diameter of the drill and on the material to be drilled the dimension *t* should lie between 0.002 inches and 0.030 inches.

A method of making a twist drill as described above includes the steps of forming a fluted body with primary lands and with at least one secondary land associated with each primary land, and of relieving the primary lands in such a way that the drill point runs out into the periphery of each primary land at a smaller diameter than said point runs out into the periphery of each secondary land, the step of relieving the primary lands being effected either by chamfering, by grinding, adjacent the drill point so that said drill point extends along the edge of a major flank and along the edge of a minor flank produced by the chamfering operation, the extent of the chamfer being such that a sizing flank of the or each secondary land is caused to stand axially "proud" of its associated primary land, or, alternatively, the step of relieving the primary lands being effected by reducing, by grinding, the diameter of the drill across said primary lands for a limited distance from the drill point so that the sizing flanks of the secondary lands are caused to stand radially "proud" of their associated primary lands.

Referring now to Fig. 9, this shows a modification which can be incorporated in either of the embodiments described above, namely the provision of a "chip" space clearance flute 28 in front of each secondary land (the cross section in which the "chip" space clearance flute has been added being, for the sake of example only, that of the drill described with reference to Figs. 5 to 8).

Various other modifications could be made without departing from the scope of the invention as set out in the appended claims. For example, in a comparatively large drill it would be quite feasible to provide two or more secondary lands in association with each primary land.

WHAT WE CLAIM IS:—

1. A twist drill having primary lands and at least one secondary land associated with each primary land, the secondary lands extending along the body clearance diameter of the drill in circumferentially spaced relation to the associated primary lands, the primary lands being relieved by being chamfered off at an angle adjacent the drill point so that the drill point extends along the edge of a major flank and along the edge of a minor flank produced by the chamfer, the chamfer being such that it runs out into the periphery of the primary land at a greater distance from the chisel edge at the tip of the drill than the major flank runs out at the periphery of the or each associated secondary land whereby each secondary land is caused to stand axially "proud" of its associated primary land and forms a sizing flank for taking a "skimming" cut following the cut taken by said primary land, or, alternatively, the primary lands being relieved by the diameter across said primary lands being less than the diameter across the secondary lands for a limited distance from the drill point so that each secondary land is caused to stand radially "proud" of its associated primary land and forms a sizing flank for taking a "skimming" cut folowing the cut taken by said primary land.

2. A twist drill according to claim 1, in which the distance over which the primary lands are relieved by being chamfered off at an angle adjacent the drill point or by the diameter across the primary lands being less than the diameter across the secondary lands, as the case may be, extends less than a distance of twice drill diameter from the drill point.

3. A twist drill according to either one of the preceding claims, in which the roots of the drill flutes are formed in such a way that the "chips" produced when the drill is in work are turned through an angle such that they fracture.

4. A twist drill according to any one of the preceding claims, in which a flute is provided in front of each secondary land to act as a "chip" space clearance flute.

5. A method of making a twist drill, the method including the steps of forming a fluted body with primary lands and with at least one secondary land associated with each primary land, and of relieving the primary lands in such a way that the drill point runs out into the periphery of each primary land at a smaller diameter than said point runs out into the periphery of each secondary land, the step of relieving the primary lands being effected either by chamfering, by grinding, adjacent the drill point so that said drill point extends along the edge of a major flank and along the edge of a minor flank produced by the chamfering operation, the extent of the chamfer being such that a sizing flank of the or each secondary land is caused to stand axially "proud" of its associated primary land, or, alternatively, the step of relieving the primary lands being effected by reducing, by grinding, the diameter of the drill across said primary lands for a limited distance from the drill point so that the sizing flanks of the secondary lands are caused to stand radially "proud" of their associated primary lands.

6. A twist drill formed and adapted to operate substantially as hereinbefore described with reference to and as illustrated by Figs. 1 to 4 of the accompanying drawings.

7. A twist drill formed and adapted to operate substantially as hereinbefore described with reference to and as illustrated by Figs. 5 and 6 of the accompanying drawings.

8. A twist drill formed and adapted to operate substantially as hereinbefore described with reference to and as illustrated by Figs. 7 and 8 of the accompanying drawings.

9. A twist drill according to any one of claims 10 to 12, modified as illustrated in Fig. 9 of the accompanying drawings.

10. A method of making a twist drill substantially as hereinbefore described with reference to the accompanying drawings.

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1 432 546 COMPLETE SPECIFICATION
2 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

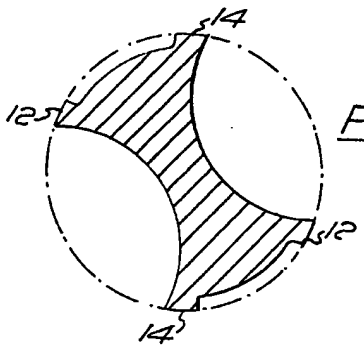

FIG. 3

FIG. 1

FIG. 2

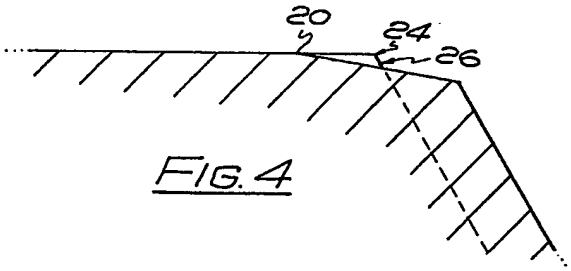

FIG. 4

1 432 546 COMPLETE SPECIFICATION
2 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

FIG. 6

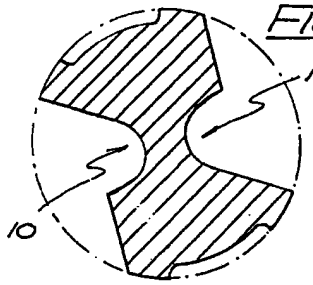

FIG. 5

FIG. 7

FIG. 8

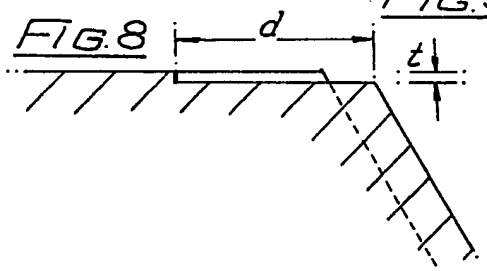

FIG. 9